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The views expressed in this paper are those of the authors.
No responsibility for them should be attributed to the Bank of Canada.

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Abstract

This paper relies on simple vector autoregressions to investigate the monetary transmission mechanism in broad sectors of the Canadian economy. Two types of disaggregation are considered: one at the level of final expenditures, and one at the level of production. At the level of final expenditures, it is found that a monetary contraction affects exports relatively quickly, and it affects investment much more substantially than the consumption of goods, while it does not seem to affect services. Not surprisingly, durables respond much more substantially than semi-durables to a monetary contraction, while non-durables do not respond significantly. At the level of production, following a monetary contraction, construction reaches the trough of the cycle first, although, cumulatively, manufacturing reacts twice as strongly. The response of the service sector is significant, but it lags manufacturing.

JEL classification: E52
Bank classification: Transmission of monetary policy

Résumé

Les auteurs font appel à de simples vecteurs autorégressifs pour étudier les effets de la politique monétaire dans les grands secteurs de l'économie canadienne. Ils examinent les données aux niveaux de la consommation finale et de la production. Un examen de la consommation finale révèle qu'une contraction monétaire se répercute sur les exportations assez rapidement et a une incidence bien plus prononcée sur l'investissement que sur la consommation de biens, sans influer apparemment sur la consommation de services. Conformément aux attentes, la consommation de biens durables réagit davantage à une contraction monétaire que celle de biens semi-durables, alors que celle de biens non durables n'y réagit pas de façon notable. En ce qui concerne la production, le secteur de la construction est le premier à toucher le creux du cycle après une contraction monétaire, mais la réaction cumulative dans le secteur de la fabrication est du double. Dans ce cas-ci, le secteur tertiaire réagit à la contraction, mais moins rapidement que le secteur de la fabrication.

Classification JEL : E52
Classification de la Banque : Transmission de la politique monétaire

1. Introduction

Past studies of the monetary transmission mechanism have usually focused on the response of aggregate variables, such as GDP and inflation, to shocks. The focus on aggregate variables results, in part, from the view that monetary policy should be concerned with the stability of the economy as a whole, and, in part, from the technical difficulty of disentangling the effects of shocks in individual sectors of the economy. Nonetheless, it is evident that different sectors of the economy respond differently to shocks. One needs to understand these differences between sectors to understand the behaviour of the economy as a whole. This paper takes a first step in investigating the monetary transmission mechanism in Canada at a sectoral level.

There are a number of difficulties in estimating the monetary transmission mechanism in Canada at a sectoral level. Foremost among them is that the sectors being studied may be too integrated to permit identification of the shocks. Another difficulty is that Canada has experienced significant changes in the composition of its economy, and in monetary policy regimes, over time. Furthermore, because the Canadian economy is influenced by a number of foreign as well as domestic variables, the sample of data available may be too small to undertake econometric estimation with sufficient confidence. Yet another difficulty involves the specification of output. Conceptually, it is most intuitive to use the notion of an output gap. There is no consensus, however, on how to measure this variable for the economy as a whole, let alone for several sectors at a time. Given these complications, it is necessary to undertake partial analyses of the problem and examine the simplest cases first.

Thus, as a first step, this paper examines the transmission mechanism in very broad sectors of the economy, at the level of final expenditures and at the level of production. At the level of final expenditures, we divide the economy into private consumption of goods, private consumption of services, investment, government spending, imports, and exports. Consumption of goods, in turn, is subdivided into the consumption of durables, semi-durables, and non-durables, and investment is subdivided into residential structures, non-residential structures, machinery and equipment, and inventories. At the level of production, we divide the economy into the primary sector, construction, manufacturing, services, and government.

We rely on simple vector autoregressions (VARs) to estimate the transmission mechanisms and to exhibit broad stylized facts. VARs provide a common framework for studying the transmission mechanisms in different sectors, and they allow the estimation of simultaneous equations, although some arbitrariness is involved in the identification of the equations. We first use a VAR to estimate the transmission mechanism at the aggregate level. Then, for each sector of interest,

we specify a separate VAR by augmenting the aggregate VAR by the measures of price and output of the sector in question. Impulse-response functions to various shocks are then plotted and compared across the VARs.

A large amount of information can be gathered from the estimated VARs. Among other things, at the level of final expenditures, we find that a monetary contraction affects exports relatively quickly, and that it affects investment much more substantially than the consumption of goods, while it does not seem to affect services. Among goods, we find, not surprisingly, that durables respond much more substantially than semi-durables to a monetary contraction, while non-durables do not respond significantly. These results appear to be fairly robust.

At the level of production, following a monetary contraction, construction reaches the trough of the cycle first, although, cumulatively, manufacturing reacts twice as strongly. The response of the services sector is significant, but it lags manufacturing. However, these results are sensitive to the model specification, perhaps because of the high integration between the different sectors at the level of production.

This paper is organized as follows. Section 2 reviews the literature that is most closely related to this study. Section 3 describes the data and methodology adopted in the paper. Section 4 discusses the main results, and Section 5 concludes and describes future research.

2. Review of the Literature

A large body of literature seeks to identify the determinants of industrial behaviour. This literature has typically endeavoured to determine the role of individual characteristics, such as market concentration or the durability of goods, in the behaviour of a particular variable, such as prices, in an industry. The focus has usually been on single equations. This paper looks at the monetary transmission mechanism as a whole, and accordingly estimates several equations simultaneously. Also, it takes a more practical approach than the literature in that it examines broad sectors of the economy rather than individual characteristics.[1] We review below some of the most closely related studies.

1. Of course, the choice of some sectors, for instance the durable-goods sector, is related to individual characteristics. However, no attempt is made to isolate the role of one individual characteristic from another. Thus, while durability may be an obvious factor driving differences in behaviour between the durable-goods and non-durable-goods sectors, other factors, perhaps a concentration of relatively larger firms in the durable-goods sector, may also be at play.

Haimowitz (1996) uses annual data across 450 standard industrial classification (SIC) 4-digit manufacturing industries in the United States to examine how industry prices and output respond to monetary shocks, and to examine how those responses are affected by certain industry characteristics. The industries are classified according to whether they produce durable goods or not, are highly concentrated or not, produce goods for producers or goods for consumers, and whether they are able to hold relatively high levels of inventories or not.

Haimowitz finds that durable-goods industries exhibit substantially larger output and marginally larger price responses to monetary shocks than non-durable-goods industries; industries producing goods for producers exhibit substantially larger output and price responses to monetary shocks than industries producing goods for consumers; high-concentration industries exhibit relatively smaller price responses and larger output responses; and industries with a high inventory-to-sales ratio exhibit relatively smaller price responses.[2]

Ganley and Salmon (1997) compare the response of output to a monetary shock in nine major sectors[3] and 24 subsectors of the U.K. economy. For that purpose, they estimate for each industrial sector a separate vector error-correction model involving the interest rate, aggregate GDP, the GDP deflator, and the sectoral output. Identification is achieved via Choleski decompositions (using the same order in which the variables were just listed). Among the nine major sectors, they find that construction, distribution and transportation, and manufacturing exhibit the largest output responses to a monetary shock. Government services, financial services, and utilities respond relatively little to the shock. The mining sector's response is somewhat erratic and ambiguous, and the agricultural sector's response is insignificant. Over all the subsectors, those industries closely linked to the construction sector react substantially fairly quickly (within a year), those linked to consumer durable and semi-durable goods, such as motor vehicles, react substantially with a lag (within 2 years), and those linked to food show only a modest response. Sectors that are closely linked to industrial demand, such as machinery and chemicals, react substantially with a slight lag, and they reach their maximum decline with a significant delay (over 2 years).

Hayo and Uhlenbrock (1999) use VARs on monthly data over the period 1978Q1–1994Q12 to study the impulse responses of 28 industries in the manufacturing and mining sector in Germany to monetary shocks.[4] They include five lags and the seven following explanatory variables: the

2. The output response in industries with a high inventory-to-sales ratio is somewhat puzzling: it appears to be larger across all goods but smaller across durable goods, which is strange, since one would expect that durability would strengthen the finding of large output response.
3. Mining, utilities, manufacturing, financial services, government services, distribution, transport and communication, agriculture, and construction.
4. Hayo and Uhlenbrock's paper also examines regional differences.

exchange rate against the dollar, a world commodity price index, a short- and a long-term interest rate, a monetary aggregate, a production index, and a producer price index. For individual industries, the latter two variables consist of their relative values with regards to the whole manufacturing and mining sector. Relative values have the advantage of allowing tests for similar behaviour between one industry and the whole economy. The VAR is identified via a standard Choleski decomposition according to the order in which the above-noted variables are listed (on the basis that the interest rate might react contemporaneously to current changes in the exchange rate and commodity prices, but reacts to other variables with a lag).

At the level of the overall manufacturing and mining sector, the results conform with stylized facts. Following a monetary tightening, output starts to drop after roughly 5 months. However, it drops significantly only after 1 year, reaches its trough in 2 years, and returns to its initial state in less than 3 years. Producer prices decline after 8 months and return to normal after 3 or 4 years, although these movements are statistically insignificant. At the industry level, Hayo and Uhlenbrock find a wide difference in terms of the period of the effect, its length, and its magnitude, with more than half the total output accounted for by industries that behave differently from the average. They attempt to classify their findings in terms of certain industry characteristics, such as the intensity of use of capital stock and export orientation.

3. Data and Methodology

At the aggregate level, we used data from Canada and the United States to describe real economic activities, prices, and policy instruments. Appendix A describes the mnemonics and the source of the data. The data cover the period 1961 to 1999, at a quarterly frequency, and involve variables pertaining to output, inflation, commodity prices, interest rates, and exchange rates. The measure of output in Canada is the real GDP in 1992 prices,[5] seasonally adjusted at annual rates, and the measure of inflation is the log-difference of the CPI, excluding food, energy, and the effect of changes in indirect taxes. Real crude oil prices and the real non-energy commodity price index are both in U.S. dollars deflated by the U.S. consumer price index (excluding food and energy). Instead of the interest rate level, we use the real spread; that is, the difference between the 90-day prime corporate paper and the 10-years-and-over Government of Canada bond yield average deflated by the CPI inflation rate, excluding food and energy. The real exchange rate is defined as

5. Our measures do not incorporate the changes in the measures of GDP in the national accounts since May 2001. For real GDP at market prices, these changes involve a move to chain volume measures, while those for real GDP at factor cost involve a move to real GDP at basic prices.

the U.S.–Canada nominal exchange rate (e.g., the price of a unit of domestic currency in terms of the U.S. currency) multiplied by the ratio of the Canadian GDP deflator to the U.S. GDP deflator.

For the United States, the variables used correspond roughly to their Canadian counterparts. The real GDP is the U.S. Department of Commerce chain volume real GDP measure, in 1996 prices, seasonally adjusted at annual rates. The inflation measure is the log-difference of the CPI, excluding food and energy. The monetary policy instrument is proxied by the federal funds rate, deflated by the inflation rate.

We explore two forms of disaggregation in Canada: expenditure and production. On the expenditure side, we separate final expenditures into private consumption of goods, private consumption of services, investment, government spending, imports, and exports. All expenditure measures are expressed in 1992 market prices, and are seasonally adjusted at annual rates. The corresponding price deflators (the ratio of nominal to real expenditures) are used to construct sector-specific inflation rates. Figure 1 describes the shares of these components as of 2000Q4. At that time, goods and services consumption accounted for the biggest shares of expenditure (26 per cent and 30 per cent, respectively), followed by government expenditure (20 per cent) and investment spending (13 per cent). Over time, however, these shares have displayed different patterns (Figure 2). Goods consumption has been decreasing while services consumption has been increasing. Government spending averaged around 25 per cent throughout the 1970s and 1980s, but declined significantly over the last 10 years. On the other hand, investment expenditure showed significant volatility and a somewhat increasing trend starting in the early 1990s. Finer disaggregation divides goods consumption into durable, semi-durable, and non-durable consumption. Also, investment spending is divided into spending on housing, non-residential structures, machinery and equipment, and inventory accumulation.

On the production side, the Canadian economy is divided into five sectors of production: the primary sector, construction, manufacturing, business services, and government. Output in these sectors is measured by real GDP at factor cost, in 1992 constant dollars, seasonally adjusted at annual rates. Figures 3 and 4 describe the shares of output across these sectors as of 2000Q4 and over time. Services-producing industries account for the biggest share in the Canadian economy (54 per cent), followed by the manufacturing sector (18 per cent). The share of the services sector has increased steadily since the mid-1960s, while the share of manufacturing output in total output has remained fairly stable over the last three decades. The size of the government sector started decreasing in the early 1990s, while the share of the primary sector decreased from around 11 per cent in 1961 to 5 per cent in 2000. The prices in the primary sector are proxied by the commodity price index. The industrial products price index (IPPI) for all manufacturing

industries is used for the manufacturing sector. In the three remaining sectors, price deflators are used.

There are many possible ways to represent output in the transmission mechanism. A common practice at many central banks is to use the notion of output gap. However, given the well-known difficulties in measuring this variable,[6] we used 4-quarter output growth as the explanatory variable in the VARs. The results obtained from VARs, using some notion of an output-gap[7] instead, were, at least qualitatively, very similar.

The various transmission mechanisms are estimated by means of VARs involving four blocks of variables. One block consists of the United States growth in real GDP; the change in a real non-energy commodity price index; the change in the price of oil; the United States CPI inflation rate, excluding food and energy; and the United States real federal funds rate. This block of variables is assumed to be exogenous to the Canadian economy, reflecting the fact that Canada is a small economy. The second block of variables consists of Canadian prices at the sectoral level (to be specified in the sequel) and the core CPI inflation, excluding food, energy, and the effect of changes in indirect taxes. The third block consists of Canadian real output growth at the sectoral and aggregate levels. Finally, the fourth block includes the Canada–U.S. real exchange rate and the instrument of monetary policy, represented by the real yield spread.

The VARs are identified via standard Choleski decompositions, where the variables are ordered in the manner they are listed above. The block of Canadian prices is placed before that for output, to allow a contemporaneous effect of sectoral relative prices on sectoral output. However, the results were robust to changes in the order of these two blocks, as well as in the order of the variables within the two blocks. The policy instrument is placed last, to capture the idea that monetary policy may adjust to current events but its effects on output and prices occur with a lag.

The model described above is used first to estimate the transmission mechanism at the aggregate level by omitting all sectoral prices and output from the VAR. Then, a separate VAR is estimated for each sector of interest by adding the measures of price and output for the sector in question to the latter VAR. Impulse-response functions to various shocks are then plotted and compared

6. Figure 5 plots, all in the same graph, 4-quarter output growth in Canada, together with three alternative measures of the output gap: one obtained as the difference between output and a trend based on an H-P filter; one where the trend is measured by means of an approximate band-pass (B-P) filter, as developed by Baxter and King (1995); and one based on a multivariable filter as used in the Bank of Canada Quarterly Projection Model (QPM). It is apparent that differences between the four measures are substantial and persistent. However, the three measures of the output gap are highly correlated together (a degree of correlation around 0.8), as well as correlated with output growth (a degree of correlation with output growth, lagged one or two periods, around 0.6).
7. Namely, from those described in the previous footnote.

across the VARs. We shall compare the responses of the various sectors (e.g., output and prices) to monetary shocks, as well as the responses of aggregate output and aggregate inflation to sectoral shocks.

4. Results

4.1 The aggregate level

As a benchmark, the transmission mechanism is first estimated at the aggregate level. The results for both the United States and Canada are consistent with conventional wisdom.[8] For example, the estimated impulse-response functions for the United States and Canada[9] (Figures 6 and 7, respectively) show that, following a tightening in interest rates, output growth in either country declines and reaches the bottom of the trough after 4 or 5 quarters. In turn, the decline in output leads to a decline in inflation, with the maximum effect reached in roughly 12 quarters. Interestingly, in Canada, the response of inflation shows two phases of decline, the earlier phase perhaps being associated with the increase in the real exchange rate caused by the rise in interest rates.

4.2 Final expenditures

Next, the transmission mechanism is examined at the level of final expenditures, whereby expenditures are divided into consumption of goods, consumption of services, government expenditures, investment, imports, and exports. Consumption of goods is, in turn, divided into durables, semi-durables, and non-durables consumption, and the investment sector is divided into machinery and equipment, housing, non-residential construction, and inventory accumulation.

For each sector we specify a separate VAR, with the real output growth and inflation of the sector in question added to the variables in the aggregate VAR described above. Figures 8 to 12 plot the impulse responses that result from the individual sectoral VARs and the aggregate VAR. (To allow comparison between the impulse responses taken from different VARs, all the shocks have been normalized to equal a unit deviation.)

Figure 8 shows that, as expected, following a monetary contraction (represented by a unit increase of the Canadian yield spread), government spending responds somewhat counter-cyclically, and

8. See, for example, Duguay (1994) for an analysis of the transmission mechanism in Canada.
9. In these figures, each row contains the impulse-response functions of the dependent variable to various shocks. For example, the last column describes the responses of the endogenous variables to a monetary contraction measured by an increase in the yield spread of one standard deviation point.

services do not respond significantly, while goods contract roughly twice as much as total GDP. A strong effect is observed in expenditures on investment,[10] which is reflected to some extent in imports, as the latter includes a large share of machinery and equipment. The quick effect on exports is likely to be caused by an increase in the exchange rate.

Figures 11 and 12 plot the effects of a monetary shock on subsectors of the goods and investment sectors. As expected, the contraction of expenditures on durable goods is substantially larger and earlier than on semi-durables. The reason for the initial increase in expenditures on semi-durables is unclear (the substitution effect?); the effect of the shock on non-durable goods is insignificant. In the investment sector, the contraction in non-residential construction is observed first, but it also bottoms out after only two quarters, and is the smallest in magnitude. This is somewhat surprising. Non-residential construction is usually thought to respond very slowly to shocks, owing to implementation lags. The qualitative effects on machinery and equipment and on housing are somewhat similar: both reach their trough in approximately 5 quarters, but housing contracts twice as much and appears to experience a secondary cycle in approximately 10 quarters. Finally, the effect on inventories appears to be quite volatile, showing an initial increase. A small initial increase is also observed in housing and in machinery and equipment.[11]

4.3 Production

As stated earlier, at the production level the domestic economy is divided into five major sectors: the primary sector, which includes agriculture, fishing and trapping, and mining industries; manufacturing; services; construction, both residential and non-residential; and government.

Figure 13 plots the impulse response to a monetary contraction.[12] The response in manufacturing is remarkably strong: a 1 percentage point increase in the real yield spread leads to an approximately equal drop in output growth in manufacturing. The response in the services sector

10. Recall, though, that the dependent variable utilized is investment growth. This may explain the remarkably strong effect observed on investment expenditures.
11. It is interesting to also examine the effects of sectoral output shocks on aggregate inflation and output growth (Figures 9 and 10). Shocks to output in the investment sector or the export sector have insignificant effects on inflation, while the effect of a shock to expenditures on imports is only slightly more evident. This is not surprising, given that all other shocks, foreign and domestic, are controlled for in the VAR. Interestingly, shocks to output in the services and goods sectors affect inflation equally. These results are consistent with the responses of aggregate output to the same shocks. The most significant effects on aggregate output are a result of shocks in the services, goods, and government sectors. (The impulse response to a shock to imports is puzzling and is suspected to be the result of an identification problem in the VAR. The response cannot be explained by movements (not shown) in the exchange rate following the shock.)
12. The primary sector is not shown in the figure, as this sector is quite volatile and the responses seemed unreliable.

is significant, in contrast to the response documented in section 4.2 on final expenditures on services. This is not surprising, given that now the services sector includes many industries involved in the handling of goods (e.g., transportation and trade). Nonetheless, the response in this sector lags all other sectors and is half as strong as manufacturing. The response in the construction sector appears to bottom out before all other sectors, but it does not lead manufacturing.[13]

5. Conclusion

This paper has investigated the monetary transmission mechanism at a sectoral level in Canada. It has considered two types of disaggregation: one at the level of final expenditures, where the economy is divided into the consumption of goods and services, investment, government spending, and imports and exports, and one at the level of production, where the economy is divided into the primary sector, construction, manufacturing, services, and government.

The paper has relied on simple VARs to estimate the transmission mechanisms. U.S. variables were included in the VAR, so that the monetary transmission mechanism in the United States was effectively estimated concurrently with that of Canada. As a benchmark, the transmission mechanism was first examined at the aggregate level. Then, for each sector of interest, a separate VAR was specified by augmenting the aggregate VAR by the measures of price and output of the sector in question. Impulse-response functions to various shocks were then plotted and compared across the VARs.

A large amount of information can be gathered from the estimated VARs. Among other things, we found that, at the level of final expenditures, exports respond relatively quickly to a monetary contraction, investment (broadly defined) responds much more substantially than does consumption of goods, and services do not respond significantly. Not surprisingly, among goods, durables respond much more substantially than semi-durables to a monetary contraction, and non-durables do not respond significantly. These results are robust to alternative specifications. At the level of production, following a monetary contraction, construction reaches the trough of the cycle first, although, cumulatively, manufacturing reacts twice as strongly. The response of the

13. The effects of sectoral output shocks on aggregate inflation and output (Figures 14 and 15) partly reflect the relative size of the sectors. Thus, an increase in output growth in the services sector has an effect that is almost twice as large on aggregate output as a similar shock to the manufacturing sector. Perhaps more surprising are the effects of the same shocks on inflation, as an increase in output in the services sector seems to have a substantially larger effect on inflation relative to its size. (The responses (not shown) of same-sector prices to the sectoral output shock have equal magnitude at their peak for services and manufacturing, but those for services lag behind and they persist considerably longer.)

services sector is significant, but it lags manufacturing. The latter results are, however, sensitive to the model specification.

The approach employed in this paper, however, does have some weaknesses. First, comparison of impulse-response functions across different VARs is open to question, as the different VARs involve different explanatory variables. Furthermore, the VARs employed do not allow for cointegration between the various sectors. A more satisfactory approach would include all the sectors simultaneously in a single vector error-correction model. While the use of Choleski decompositions seems to be appropriate for estimating the transmission mechanism across sectors at the level of final expenditures, one suspects that it is not well-suited for estimations at the level of production, because of the strong interdependence between the sectors. An alternative approach is to refine further the level of disaggregation, say to the level of two-digit-level industries, and to solve the identification problem by allowing contemporaneous interaction only between industries that have direct input-output linkages. Finally, while this paper provides strong evidence of differences in behaviour across sectors of the economy, it does not examine the implications that these differences have for the conduct of monetary policy. We hope that these topics will be the subject of future work.

References

Baxter, M. and R.G. King. 1995. "Measuring Business Cycles: Approximate Band Pass Filters for Economic Time Series." NBER Working Paper No. 5022.

Duguay, P. 1994. "Empirical Evidence on the Strength of the Monetary Transmission Mechanism in Canada: An Aggregate Approach." *Journal of Monetary Economics* 33: 39–61.

Ganley, J. and C. Salmon. 1997. "The Industrial Impact of Monetary Policy Shocks: Some Stylized Facts." Bank of England Working Paper No. 68.

Haimowitz, J.H. 1996. "Monetary Policy Shocks and Price Stickiness: An Analysis of Price and Output Responses to Policy in Manufacturing Industries." Federal Reserve Bank of Kansas City, RWP 96–07.

Hayo, B. and B. Uhlenbrock. 1999. "Industry Effects of Monetary Policy in Germany." Manuscript.

Figure 1: Shares of final expenditures in total output (in current dollars as of 2000Q4)

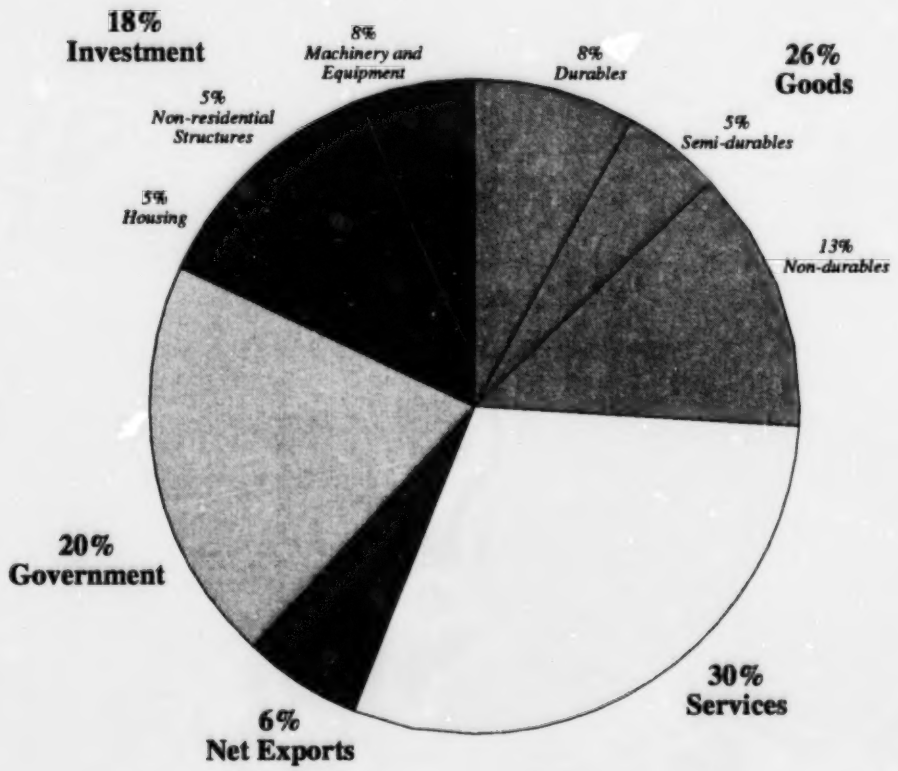


Figure 2: Shares of final expenditures in total output (in current dollars)

Figure 3: Shares of production sectors in total output (in current dollars as of 2000Q4)

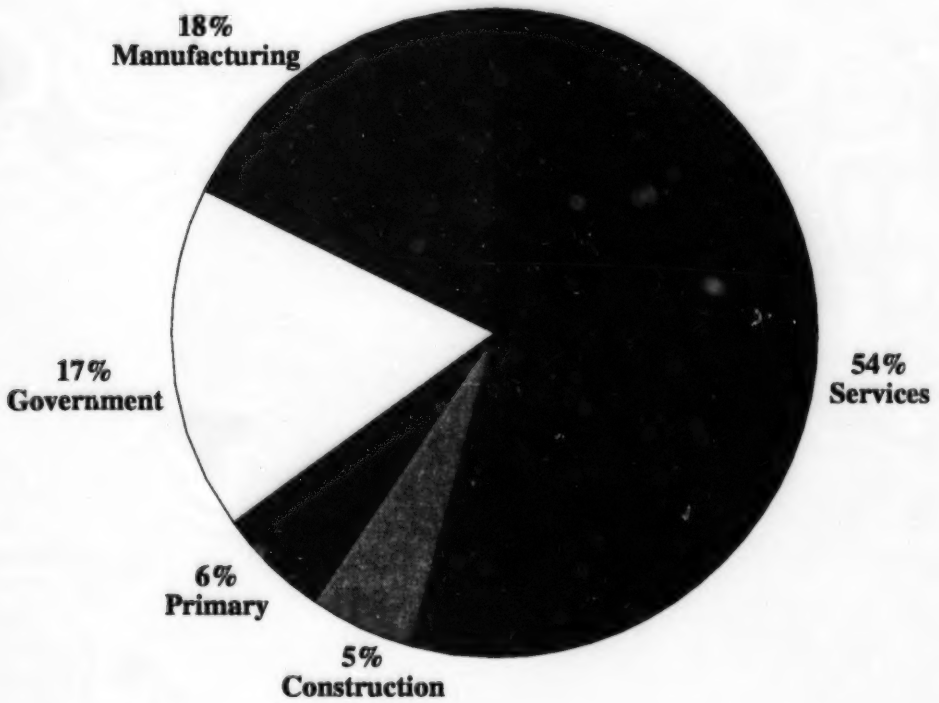


Figure 4: Shares of production in total output (in current dollars)

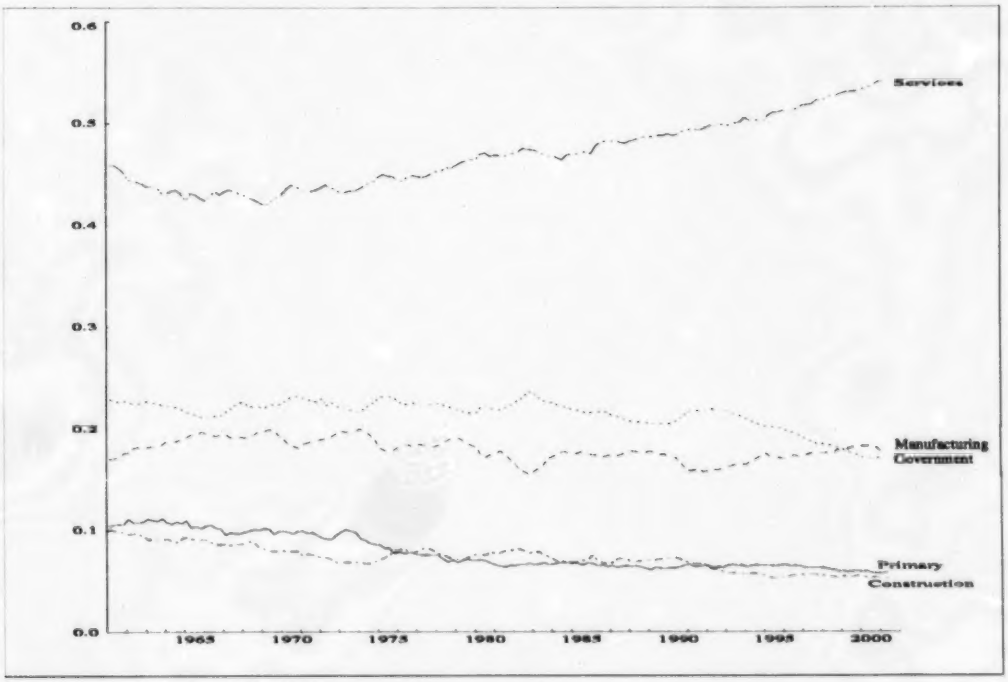


Figure 5: Alternative measures of aggregate output gap and output growth

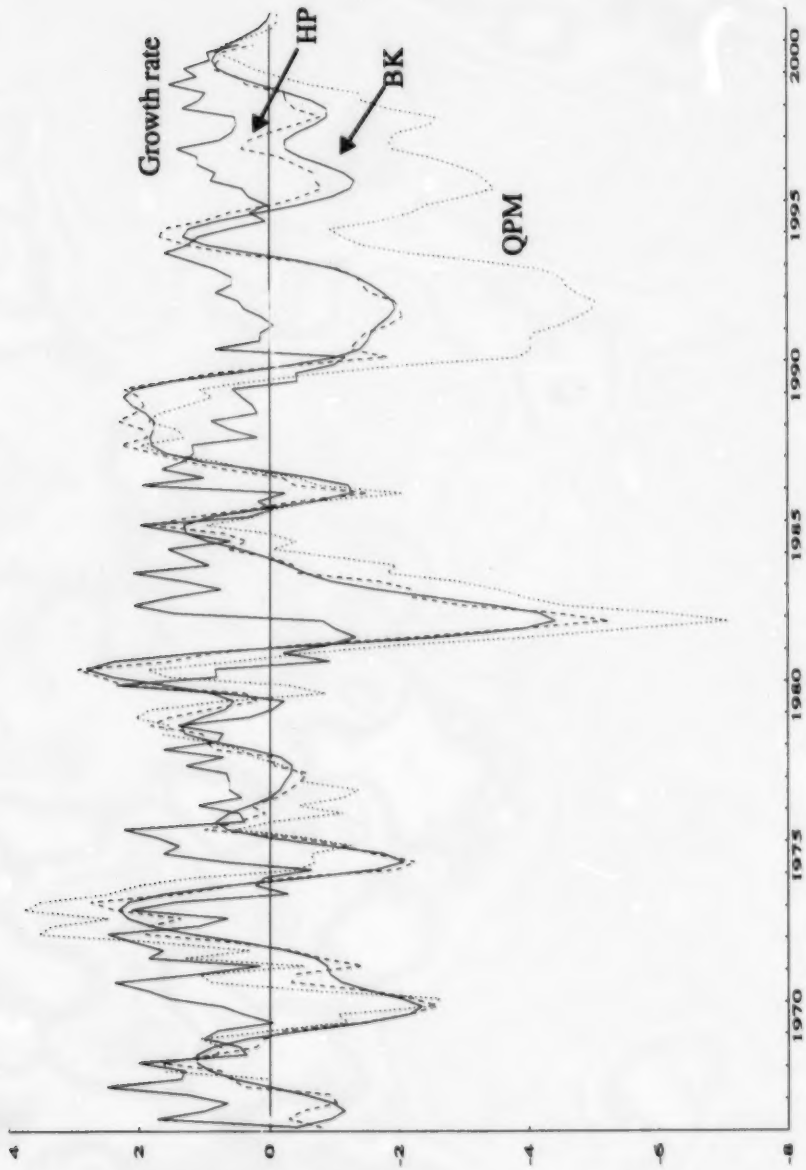


Figure 6: Impulse responses of exogenous variables to exogenous variable shocks

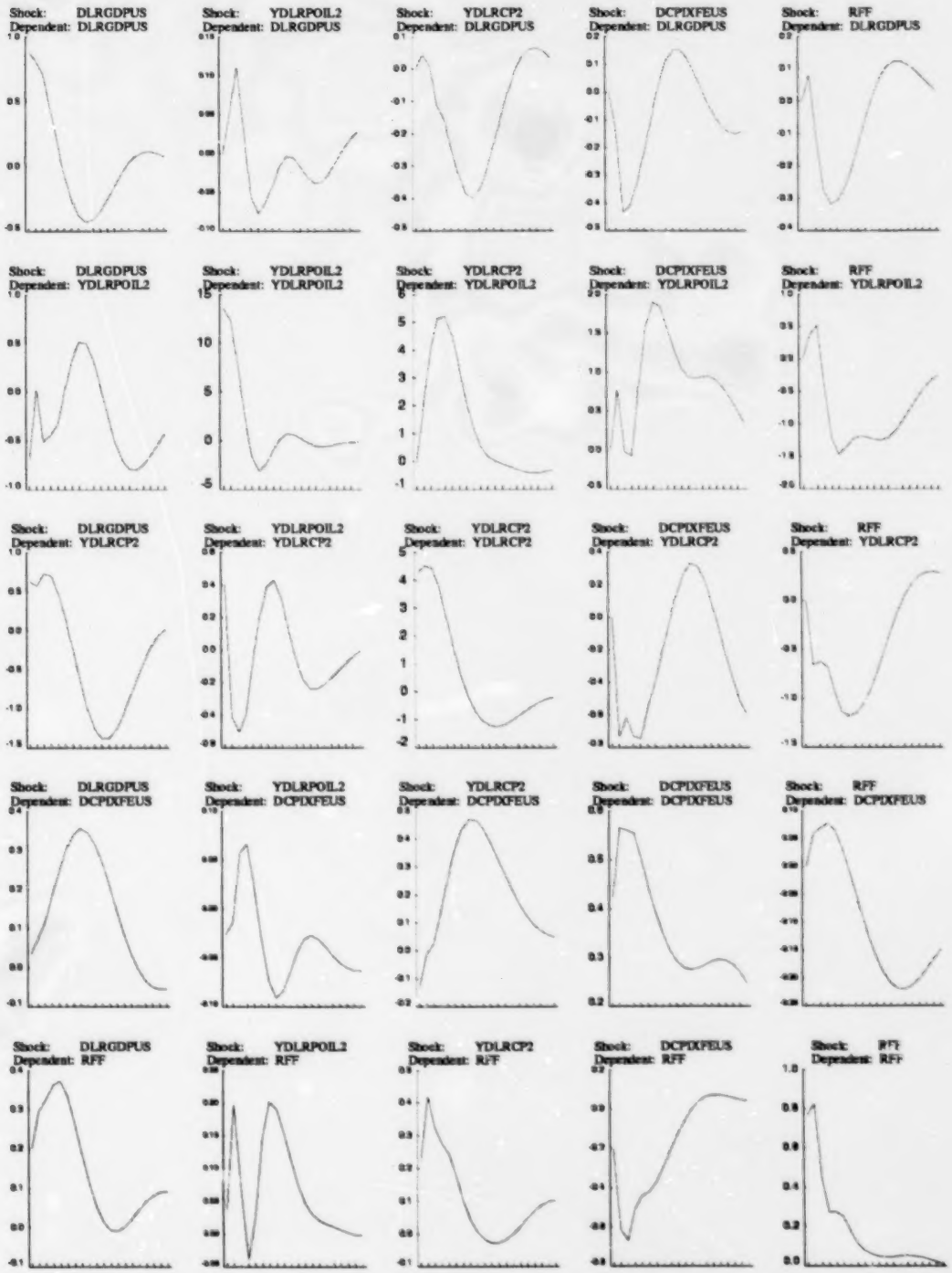


Figure 7: Impulse responses of domestic variables to domestic shocks

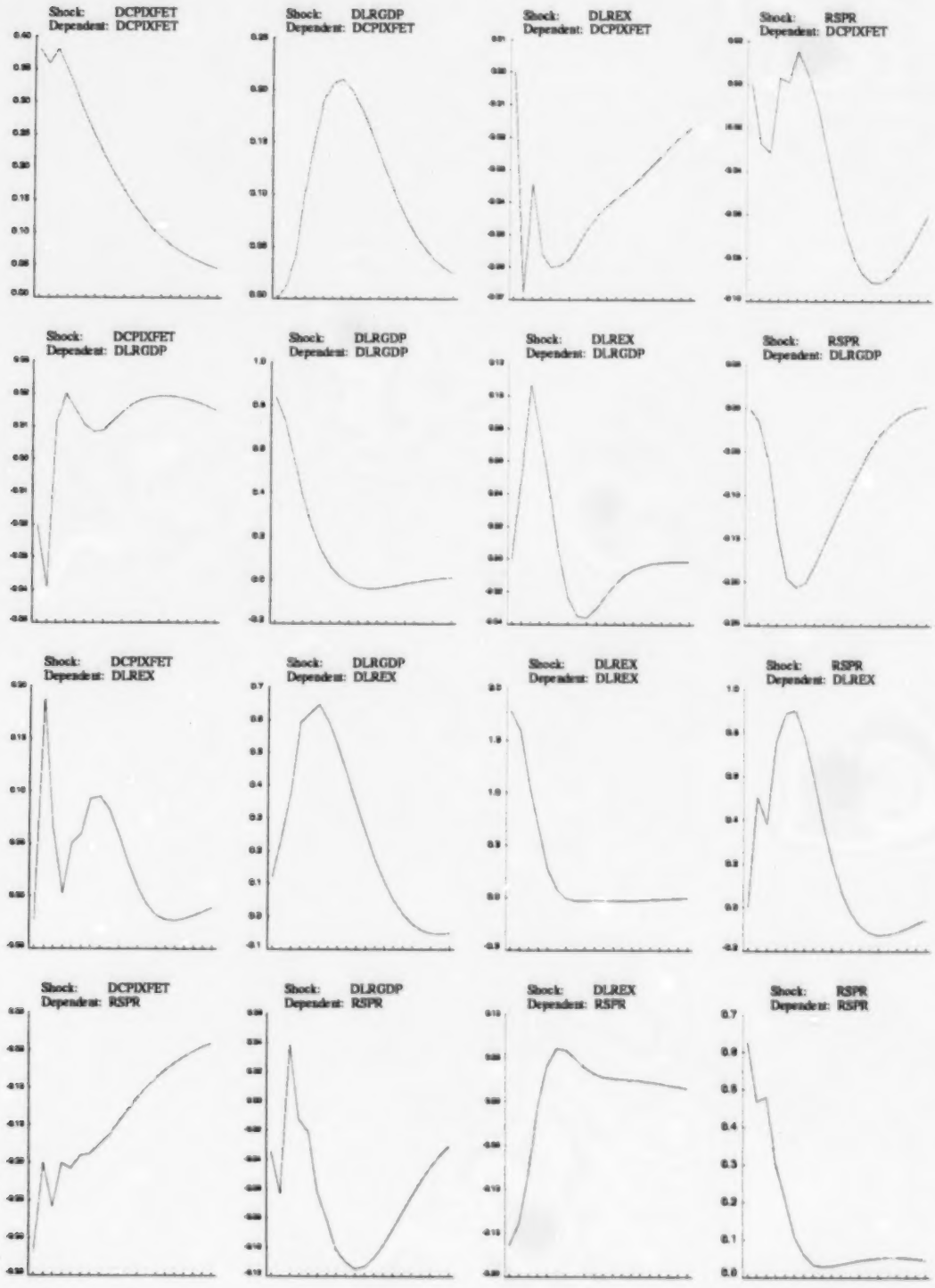


Figure 8: Impulse responses at the sectoral level

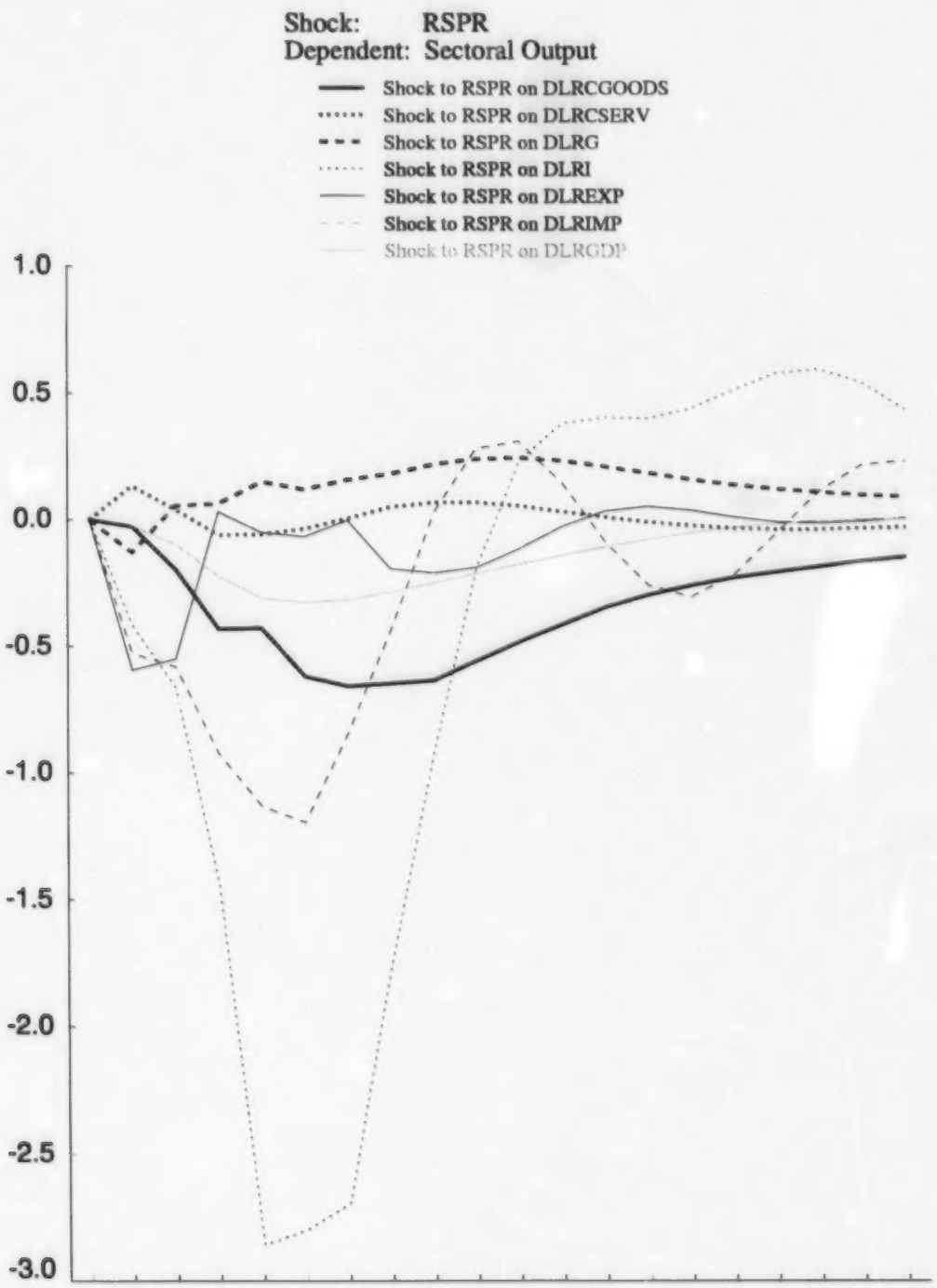


Figure 9: Impulse responses at the sectoral level

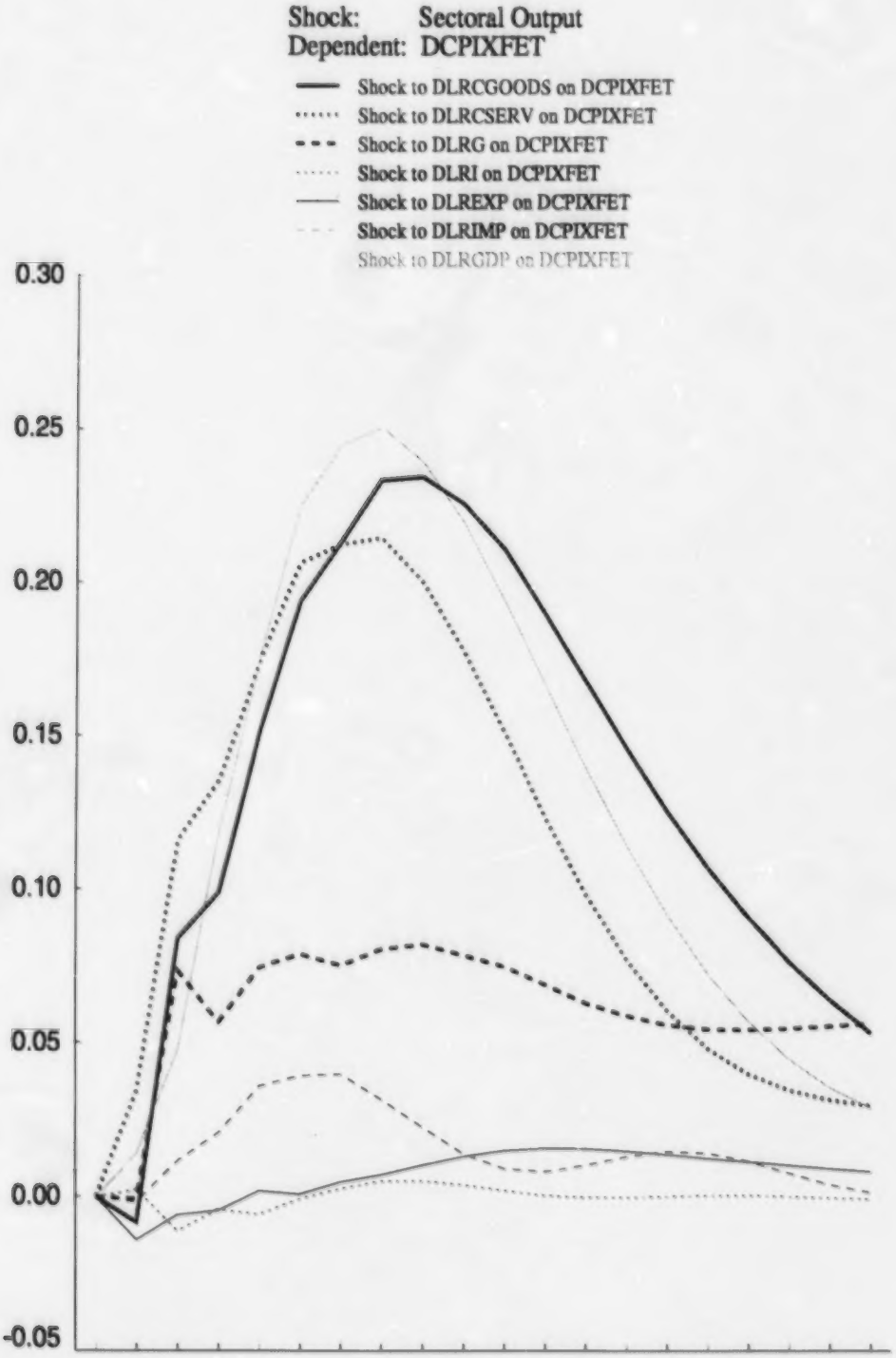


Figure 10: Impulse responses at the sectoral level

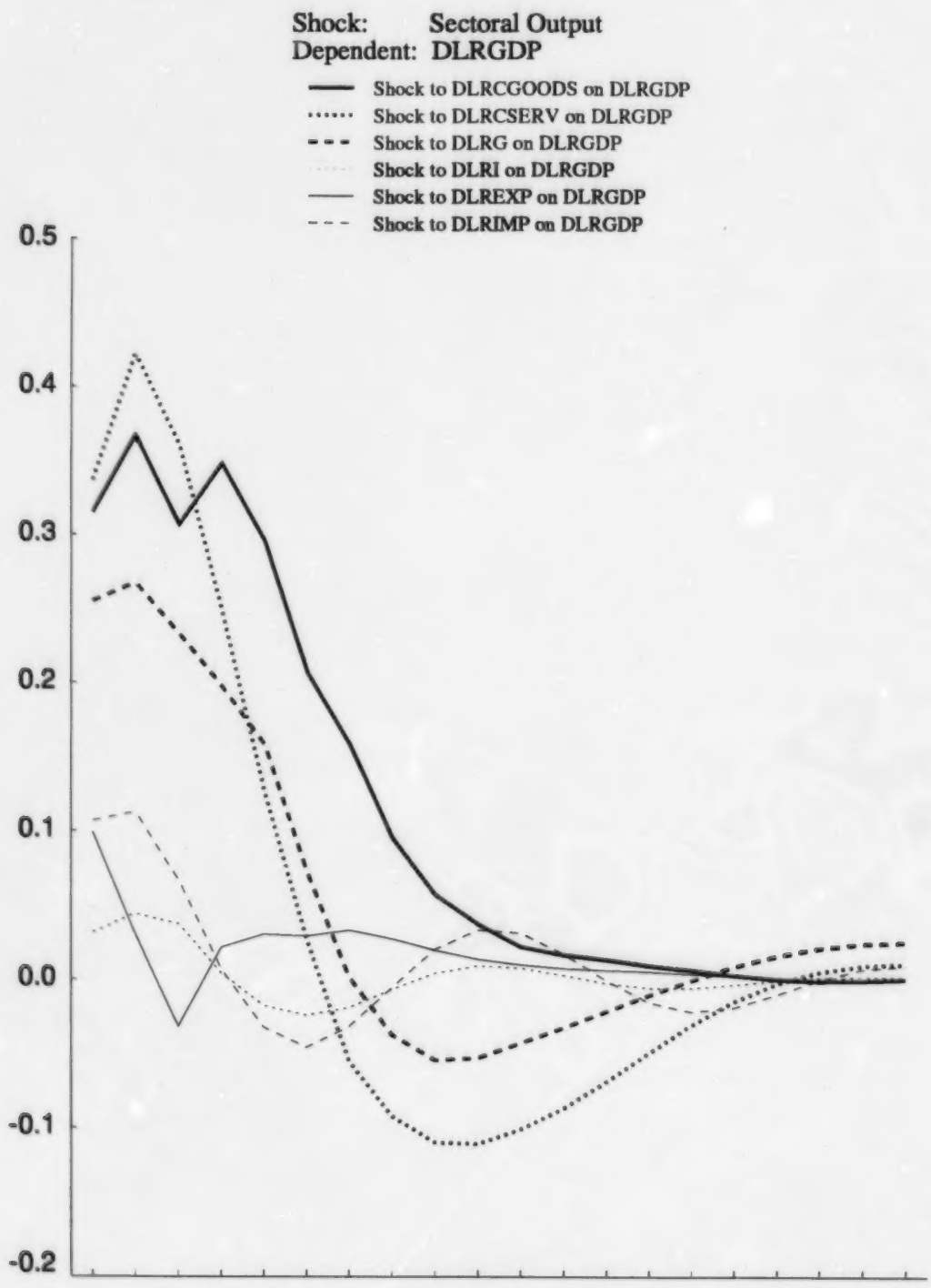


Figure 11: Impulse responses at the sectoral level

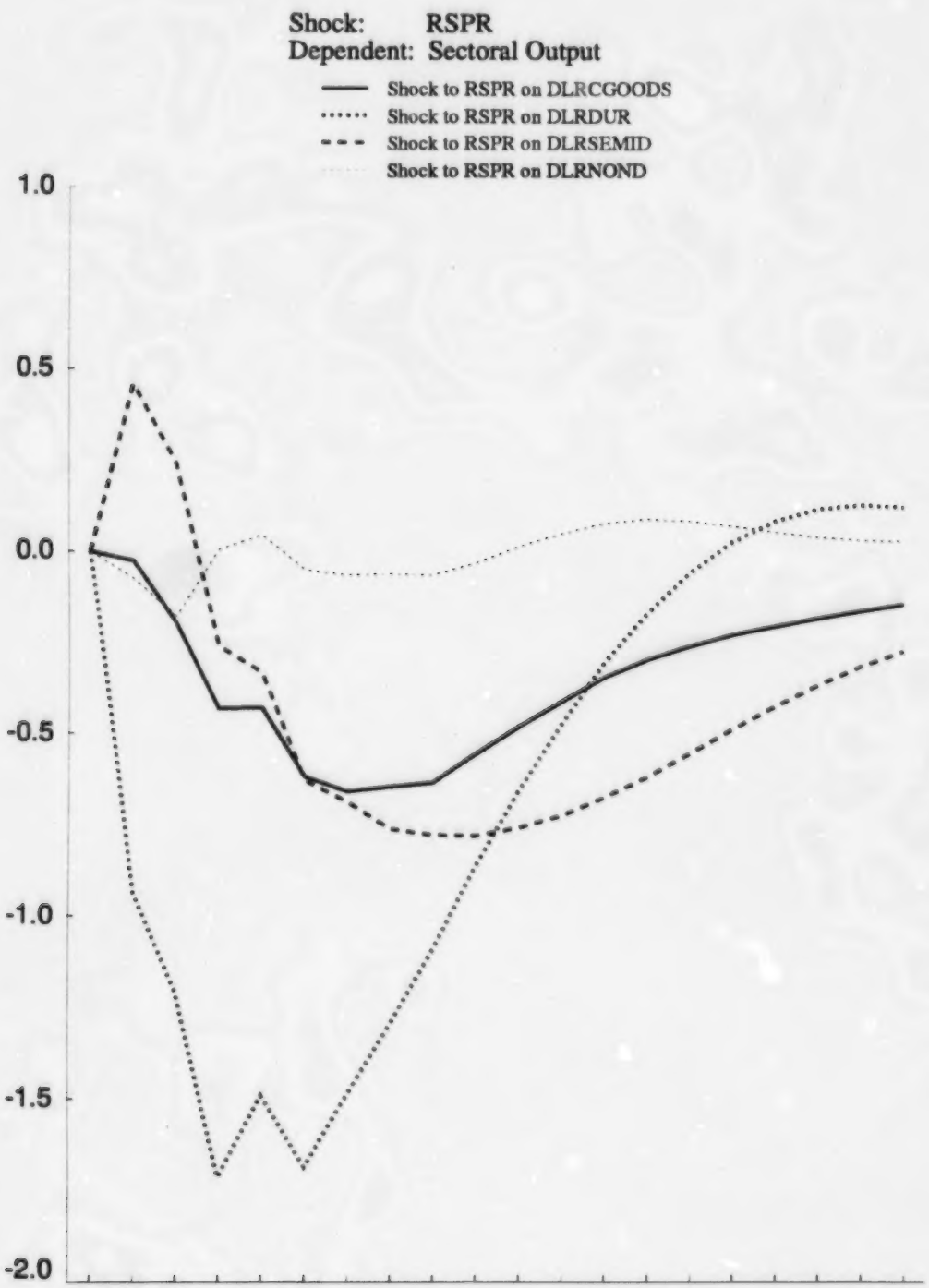


Figure 12: Impulse responses at the sectoral level

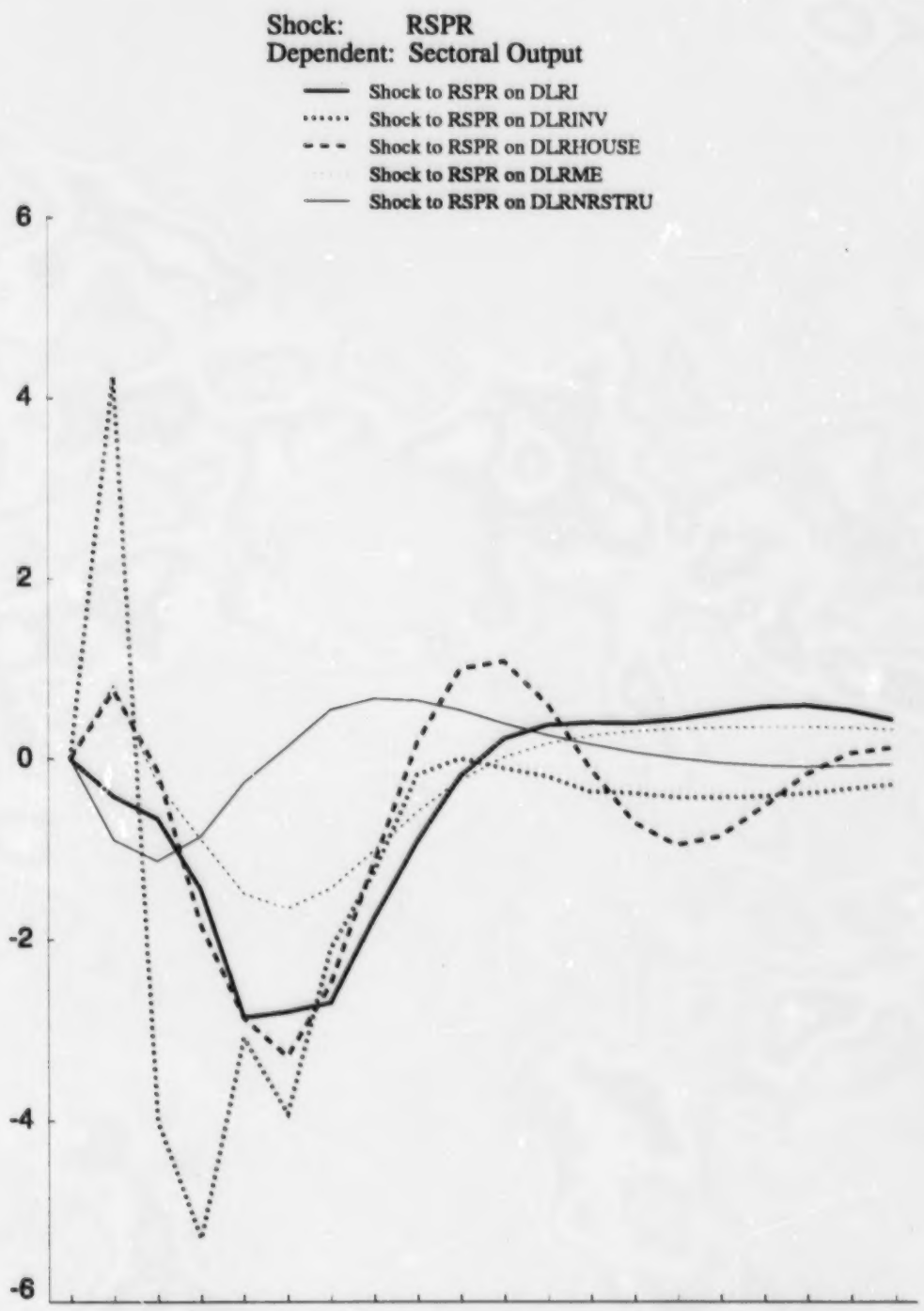


Figure 13: Impulse responses at the sectoral level

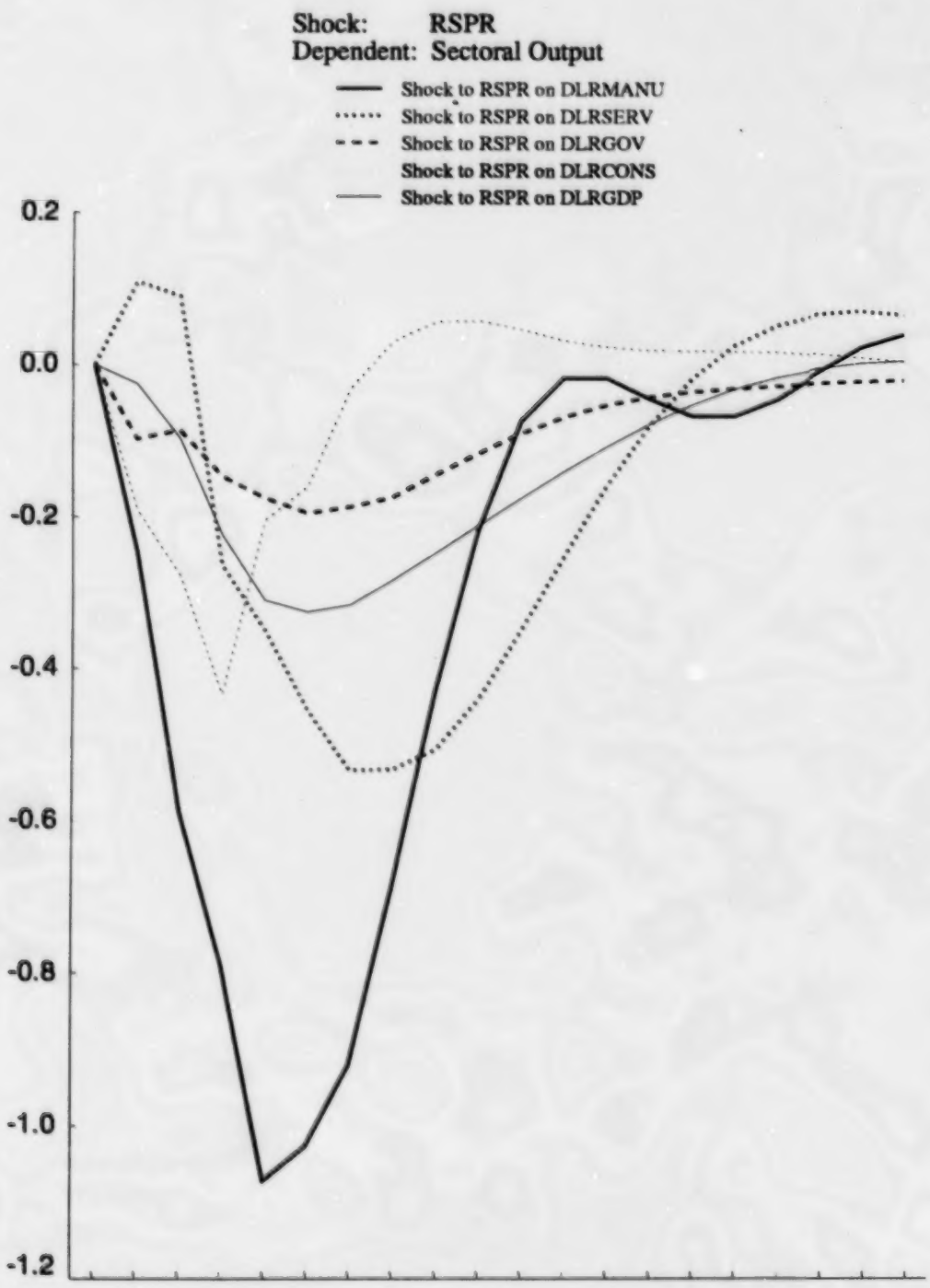


Figure 14: Impulse responses at the sectoral level

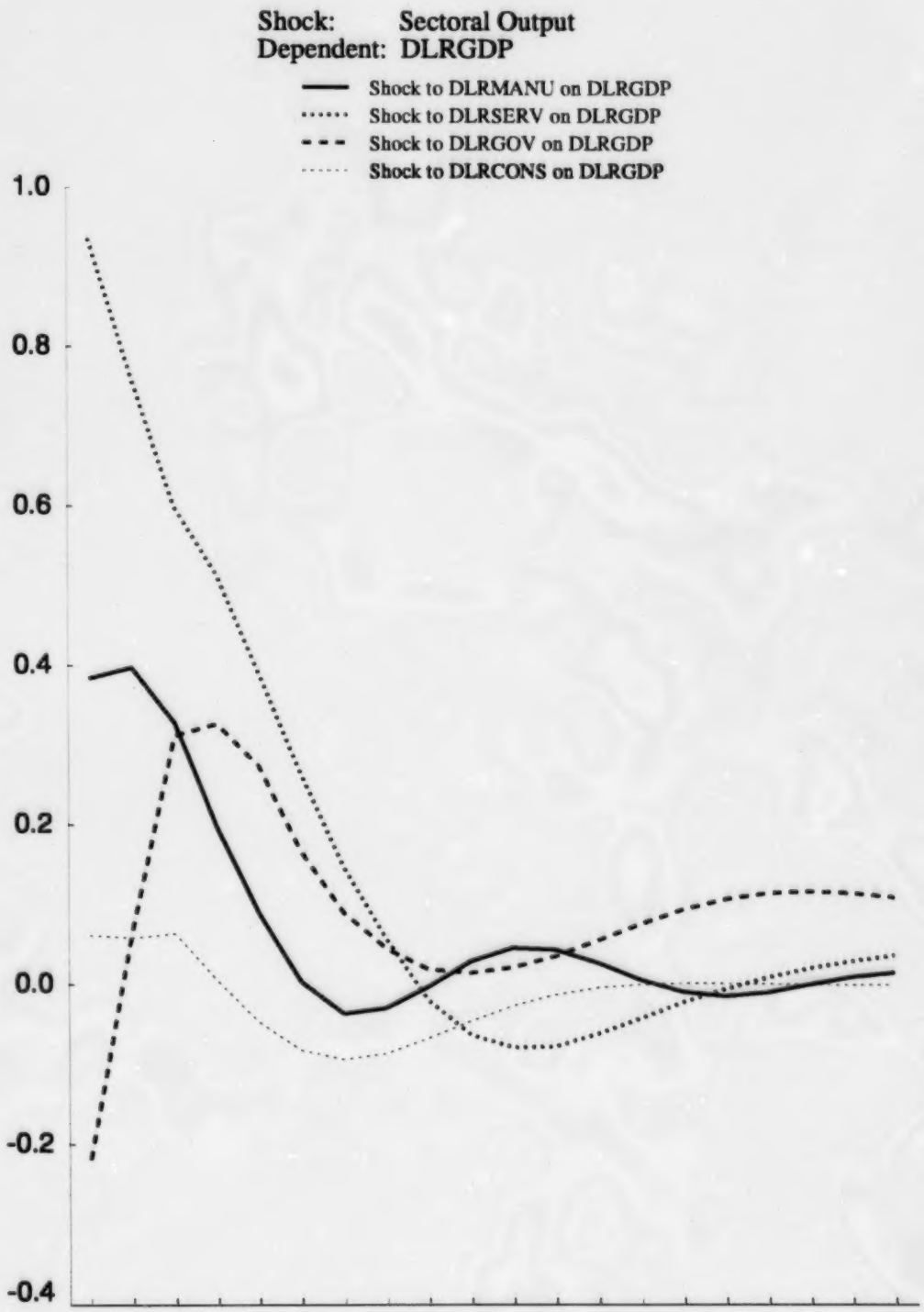
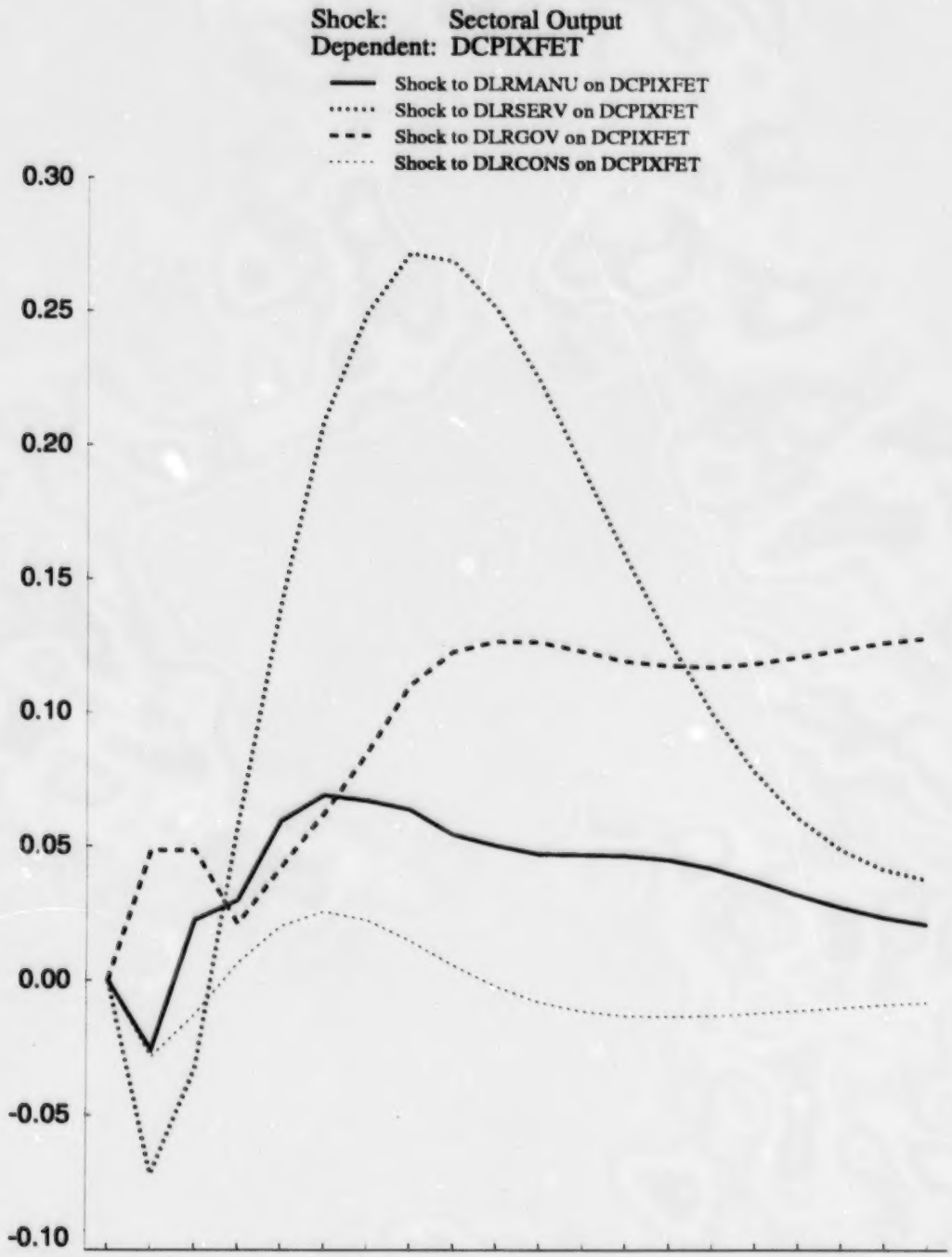


Figure 15: Impulse responses at the sectoral level



Appendix A

A.1 Mnemonics and source of data

In all series, the prefix DLR indicates first *d*ifferences of *l*ogarithms of a variable in *r*eal terms. For example, DLRGDP denotes the first difference of logarithms of real GDP.

Mnemonics	Source	Identifier
GDPUS	BEA / U.S. Department of Commerce	N/A
YDLROIL2	Bank of Canada	coil
	BoC (lise.db 1964Q1 to 1972Q1)	dlpoil
YDLRCP2	Bank of Canada	bcne
	BoC (lise.db 1964Q1 to 1972Q1)	dlrcp
DCPIXFEUS	Federal Reserve	N/A
RFF	Federal Reserve	N/A
DCPIXFET	Bank of Canada	N/A
GDP	Statistics Canada	D14872
DLREX	Bank of Canada	iexm0102
RSPR	Bank of Canada	B820655, B14017, B14013
CGOODS	Statistics Canada	D14842
CSERV	Statistics Canada	D14846
G	Statistics Canada	D14848, D14849, D14850
I	Statistics Canada	D14853, D14858
EXP	Statistics Canada	D14862
IMP	Statistics Canada	D14866
DUR	Statistics Canada	D14843
SEMID	Statistics Canada	D14844
NDUR	Statistics Canada	D14845
INV	Statistics Canada	D14851, D14858
HOUSE	Statistics Canada	D14852
ME	Statistics Canada	D14855
NRSTU	Statistics Canada	D14854
MANU	Statistics Canada	V329552
SERV	Statistics Canada	V329746, V329764, V329775, V329776, V329777, V329790, V329811, V329814
GOV	Statistics Canada	V329798, V329805, V329808
CONS	Statistics Canada	V329743
PRIM	Statistics Canada	V329832, V329837, V329838, V329536

Note: The D-numbers (1992 constant dollars) are no longer viewable on the Statistics Canada Web site. They have since been updated to a chained Fisher measurement.

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